UNIVERSIDAD NACIONAL AUTONOMA DE MEXICO

EXAMEN: 4º Parcial

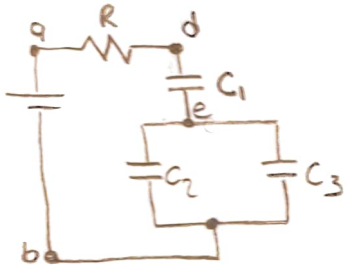
PROFESOR: Agustín Pérez Contreras

MATERIA: Electricidad y Magnetismo

NOMBRE DEL ALUMNO: Murrieta Villegas Alfonso

7.5 + 1.0

Problema 1]



Calcular		DATOS
a) Capacitor equivalente		$R = 2 \times 10^5\ \Omega$
b) $q_{eq} = ?$	if $t = \frac{1}{2} R C_{eq}$	$C_1 = 6\ \mu F$
c) $V_{db} = ?$	if $t = \frac{1}{2} R C_{eq}$	$C_2 = 5\ \mu F$
d) $i = ?$	if $t = \frac{1}{2} R C_{eq}$	$C_3 = 7\ \mu F$
e) $t = ?$	para $q = \frac{1}{2} q_{max}$	$V_{ab} = 100\ [V]$

a) $C_{2,3} = C_2 + C_3 = 12\ [\mu F]$ //

b) $q_{eq} = (V_{ab})(C_{eq})\left(1 - e^{-\frac{t}{RC}}\right)$

$= (V_{ab})(C_{eq})\left(1 - e^{-\frac{1}{2}}\right) = (100)(4 \times 10^{-6})\left(1 - e^{-\frac{1}{2}}\right) = 157.3877 \times 10^{-6}\ [C]$ //

c) $V_{db} = V_{ab}\left(1 - e^{-\frac{t}{RC}}\right)$ if $t = \frac{1}{2} R C_{eq}$

$V_{db} = V_{ab}\left(1 - e^{-\frac{1}{2}}\right) = (100)\left(1 - e^{-\frac{1}{2}}\right) = 39.3169\ [V]$ //

d) $i = \frac{V_{ab}}{R} e^{-\frac{t}{RC}}$ if $t = \frac{1}{2} R C_{eq}$

$i = \frac{100}{2 \times 10^5} e^{-\frac{1}{2}} = 303.2653 \times 10^{-6}\ [A]$ //

1.5

e) $q = q_{max}\left(1 - e^{-\frac{t}{RC}}\right)$ if $q = \frac{1}{2} q_{max}$

$\therefore 1 - e^{-\frac{t}{RC}} = \frac{1}{2}$; $-\frac{t}{RC} = \ln\frac{1}{2}$; $t = -RC \ln\frac{1}{2}$

$t = -(2 \times 10^5)(4 \times 10^{-6})\left[\ln\left(\frac{1}{2}\right)\right] = .5545\ [\text{Segundos}]$ //

continua →

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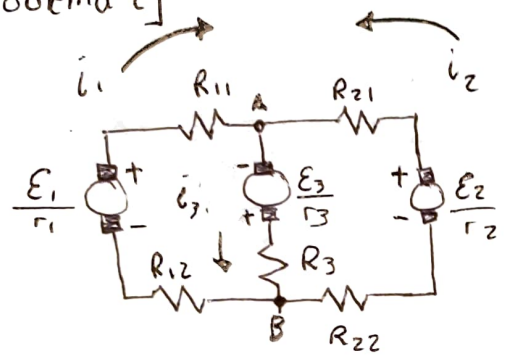
Problema 2]



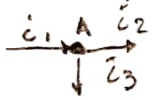
$R_{11} = 4\ \Omega$
$R_{12} = 6\ \Omega$
$R_{22} = 7\ \Omega$
$R_{21} = 5\ \Omega$
$R_3 = 8\ \Omega$

$r_1 = 3\ \Omega$
$r_2 = 2\ \Omega$
$r_3 = 1\ \Omega$
$\mathcal{E}_1 = 100[V]$
$\mathcal{E}_2 = 40[V]$
$\mathcal{E}_3 = 20[V]$

Calcular

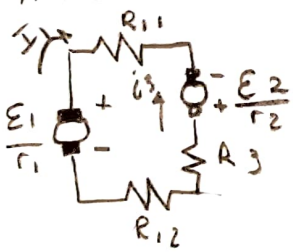
$i_1 =$
$i_2 =$
$i_3 =$
$\eta_1 =$
$\eta_2 =$
$\eta_3 =$
$V_{ab} =$

// First equation



$\rightarrow i_1 + i_2 - i_3 = 0$

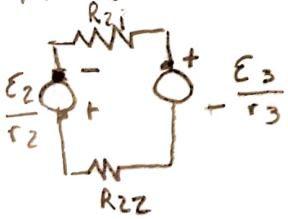
// Malla 1



$(R_{11} + r_1 + R_{12})\, i_1 + 0\, i_2 + (R_3 + r_3)\, i_3 = (\mathcal{E}_1 + \mathcal{E}_3)$

$\rightarrow 13\, i_1 + 0\, i_2 + 9\, i_3 = 120$

// Malla - 2



$0\, i_1 + (R_{21} + R_{22} + r_2)\, i_2 + (R_3 + r_3)\, i_3 = -\mathcal{E}_2 + \mathcal{E}_3$

$\rightarrow 0\, i_1 + 14\, i_2 + 9\, i_3 = 60$

// Sistema de ecuaciones

$i_1 + i_2 - i_3 = 0$

$13 i_1 + 0 i_2 + 9 i_3 = 120$

$i_1 + 14 i_2 + 9 i_3 = 60$

$$\begin{bmatrix} 1 & 1 & -1 & 0 \\ 13 & 0 & 9 & 120 \\ 0 & 14 & 9 & 60 \end{bmatrix} \sim \begin{bmatrix} 1 & 0 & 9/13 & 129/13 \\ 0 & 1 & 22/13 & -120/13 \\ 0 & 14 & 9 & 60 \end{bmatrix} \sim \begin{bmatrix} 1 & 0 & 0 & 1444/85 \\ 0 & 1 & 9/14 & 30/7 \\ 0 & 0 & \frac{425}{-182} & \frac{1230}{-91} \end{bmatrix}$$

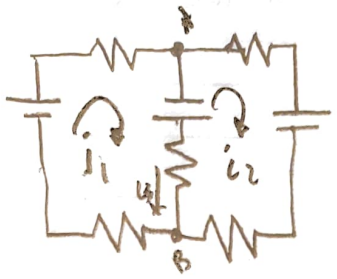
$$\begin{bmatrix} 1 & 0 & 0 & 444/85 \\ 0 & 1 & 9/14 & 30/7 \\ 0 & 0 & 1 & 492/85 \end{bmatrix} \sim \begin{bmatrix} 1 & 0 & 0 & 444/85 \\ 0 & 1 & 0 & -48/25 \\ 0 & 0 & 1 & 492/85 \end{bmatrix} //$$

$\therefore$ $i_3 = 5.7882\ [A]$ //

$i_2 = 0.5647\ [A]$ //

$i_1 = 5.2235\ [A]$ //

// Método Alternativo

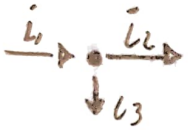


$100 - (3+4+1+8+6)i_1 + 20 + (1+8)i_2 = 0$

$-20 - (5+2+7+8+1)i_2 - 40 + (8+1)i_1 = 0$

$\therefore \begin{cases} -22i_1 + 9i_2 = -120 \\ 9i_1 - 23i_2 = 60 \end{cases}$; $i_1 = \frac{444}{85} = 5.2235$ [A] //

$\therefore i_2 = \frac{-48}{85} = -.5647 = .5647$ [A] //



$i_1 - i_2 - i_3 = 0$; $i_3 = (5.2235) - (-.5647) = 5.7882$ [A] //

// Eficiencia

// Generador // Motor

ε_1]

$\eta_1 \triangleq$ Generador $= \frac{\varepsilon_g - ir}{\varepsilon_g} = \frac{100 - (5.2235)(3)}{100} =$

$= .843295$ //

ε_3]

$\eta_3 \triangleq$ Generador $= \frac{\varepsilon_g - ir}{\varepsilon_g} = \frac{20 - (5.7882)(1)}{20} = .71059$ //

ε_2]

$\eta_2 \triangleq$ Generador $= \frac{\varepsilon_g - ir}{\varepsilon_g} = \frac{40 - (.564)(2)}{40} = .971765$ //

// Voltaje

$V_{ab} = (1+8)(5.7882) - 20 = 32.0938$ [V] //

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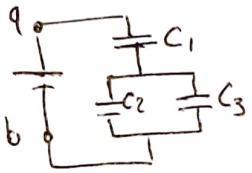
Problema 3]



$V_{ab} = 100\,[V]$

$C_1 = 6\,\mu F$

$C_2 = 5\,\mu F$

$C_3 = 7\,\mu F$

CALCULAR

$C_{eq} = d?$ $\quad V_{ad} = ?$

$q_{eq} = ?$ $\quad V_{db} = ?$

$q_1 = ?$ $\quad E_{u\,almc_1} = ?$

$q_2 = ?$ $\quad E_{u\,almc_2} = ?$

$q_3 = ?$ $\quad E_{u\,almc_3} = ?$

$E_{u\,almc_{eq}} = ?$

$C_{23} = C_2 + C_3 = 12\,\mu F$

$C_{eq} = \dfrac{1}{\frac{1}{C_1} + \frac{1}{C_{23}}} = 4\,[\mu F]$

$C = \dfrac{q}{V_{ab}}$; $q_{eq} = (C_{eq})(V_{ab})$

$\therefore q_{eq} = (100)(4 \times 10^{-6}) = 4 \times 10^{-4}\,[C]$

$V_{ab} = V_{ad} + V_{db}$; $q_{eq} = q_1 = q_2 + q_3$

$V_{ad} = \dfrac{q_1}{C_1} = \dfrac{(4 \times 10^{-4})}{(6 \times 10^{-6})} = \dfrac{200}{3} = 66.667\,[V]$

$\therefore V_{db} = V_{ab} - V_{ad} = 33.333\,[V]$

$C_1 = \dfrac{q_1}{V_{ad}}$; $q_1 = (C_1)(V_{ad}) = (6 \times 10^{-6})\left(\frac{200}{3}\right) = 4 \times 10^{-4} = 400 \times 10^{-6}\,[C]$

$C_2 = \dfrac{q_2}{V_{db}}$; $q_2 = (C_2)(V_{db}) = (5 \times 10^{-6})\left(\frac{100}{3}\right) = 166.667 \times 10^{-6}\,[C]$

$C_3 = \dfrac{q_3}{V_{db}}$; $q_3 = (C_3)(V_{db}) = (7 \times 10^{-6})\left(\frac{100}{3}\right) = 233.333 \times 10^{-6}\,[C]$

continua →

▶ Eualm

$E_{ualmc_1} = \left(\frac{1}{2}\right)(C_1)(V_{ad})^2 = \left(\frac{1}{2}\right)(6\times10^{-6})\left(\frac{200}{3}\right)^2 = .01333\ [J]$

$E_{ualmc_2} = \left(\frac{1}{2}\right)(5\times10^{-6})\left(\frac{100}{3}\right)^2 = 2.777\times10^{-3}\ [J]$

$E_{ualmc_3} = \left(\frac{1}{2}\right)(7\times10^{-6})\left(\frac{100}{3}\right)^2 = 3.888\times10^{-3}\ [J]$

$E_{almc_{eq}} = \left(\frac{1}{2}\right)(4\times10^{-6})(100)^2 = .02$

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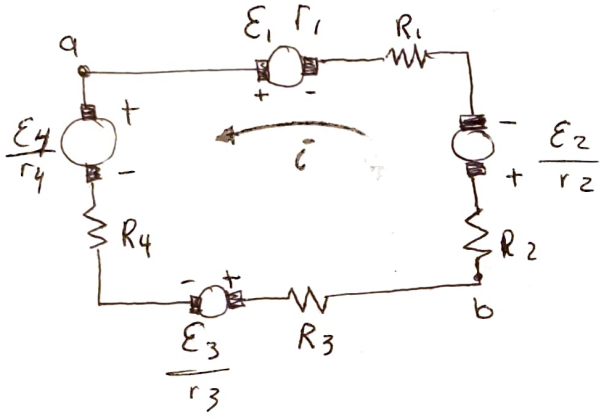
Problema 4]



$\mathcal{E}_1 = 100$ V	$R_1 = 9\ \Omega$	CALCULAR
$\mathcal{E}_2 = 60$ V	$R_2 = 6\ \Omega$	$i = ?$
$\mathcal{E}_3 = 40$ V	$R_3 = 7\ \Omega$	$V_{ab} = ?$
$\mathcal{E}_4 = 20$ V	$R_4 = 8\ \Omega$	$\eta_1 =$
$r_1 = 4\ \Omega$		$\eta_2 =$
$r_2 = 3\ \Omega$		$\eta_3 =$
$r_3 = 2\ \Omega$		$\eta_4 =$
$r_4 = 1\ \Omega$		

Generador

$$i = \frac{\Sigma \mathcal{E}}{\Sigma r} = \frac{\mathcal{E}_1 - \mathcal{E}_4 + \mathcal{E}_3 - \mathcal{E}_2}{\Sigma r} = \frac{60}{40} = 1.5\ [A]$$

$\mathcal{E}_1, \mathcal{E}_3 \triangleq$ Generadores

$\mathcal{E}_2, \mathcal{E}_4 \triangleq$ Motores

$$\mathcal{E}_g i + V_{abi} = \mathcal{E}_m + \mathcal{E} i^2 R;\quad V_{ab} = \Sigma_{1g} - (\mathcal{E}_g - \mathcal{E}_m);\quad V_{ab} = \Sigma i R - \Sigma \mathcal{E}$$

$$\therefore V_{ba} = (22)(1.5) - (100 - 60) = -7\ [V] \Rightarrow V_{ab} = 7\ [V]$$

$$V_{ab} = (18)(1.6) - (-20 + 40) = 7\ [V]$$

$$\eta_g = \frac{P_{salida}}{P_{entrada}} = \frac{\mathcal{E}_g i - i^2 r_g}{\mathcal{E}_g i} = \frac{\mathcal{E}_g - ir}{\mathcal{E}_g}$$

$$\eta_{motor} = \frac{\mathcal{E}_m i}{\mathcal{E}_m i + i^2 r} = \frac{\mathcal{E}_m}{\mathcal{E}_m + ir}$$

//Generadores

$\mathcal{E}_1$]

$$\eta_1 = \frac{100 - (1.5)(4)}{100} = .94$$

ε_3]

$$\eta_3 = \frac{40 - (1.5)(2)}{40} = .925 //$$

// Motores

$$\eta_2 = \frac{60}{60 + (1.5)(3)} = .9302 // \qquad \eta_4 = \frac{20}{20 + (1.5)(1)} = .9302 //$$

// Resumen

- Generadores | $\eta_1 = .94 //$; $\eta_3 = .925 //$
- Motores | $\eta_2 = .9302 //$; $\eta_4 = .9302 //$